LENNTECH
info@lenntech.com Tel. +31-152-610-900
www.lenntech.com Fax. +31-152-616-289

/ AV Series Cooling Tower /

Engineering Data & Specifications

Marley®
AN SPX BRAND

Engineering Data

Schematic 4
Support 8
Hoisting Info 10
Freeze Prevention 11
Environmental 12
Application 13

Specifications / Base

Base 14
Thermal Performance 15
Performance Warranty 15
Design Loading 15
Construction 16
Mechanical Equipment 17
Fill, Louvers and Drift Eliminators 18
Hot Water Distribution System 19
Access 20

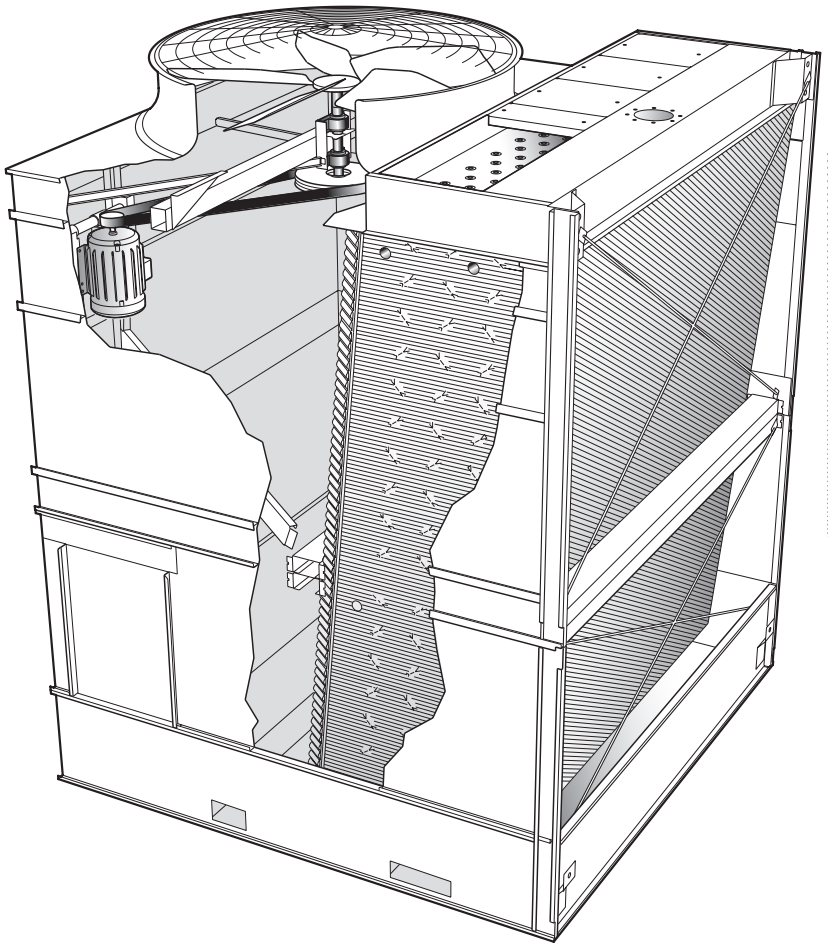
Specifications / Options

Stainless Steel Options
Stainless Steel Collection Basin 21
All Stainless Steel Cooling Tower 21

Control Options
Fan Motor Starter Control Panel 22
Vibration Limit Switch 23
Basin Heater 23

Convenience and Safety Options
Hot Water Basin Access Platform 24
Ladder Extension 24
Ladder Safety Cage 24
Mechanical Equipment Access Platform 25

Miscellaneous Options
Fan Cylinder Extensions 26
Equalizer Flume Weir Gates 26
Marley Control Valve 26
FM Approval 27
Low Noise Tower 27



AV Series towers are galvanized steel, factory-assembled, general purpose crossflow cooling towers, designed to serve normal air conditioning and refrigeration systems as well as light industrial loads. They evolve from a singleflow concept of towers pioneered by Marley in the 1950s, and incorporate all of the design advancements that our customers have found valuable. They represent the current state of the art in this cooling tower category.

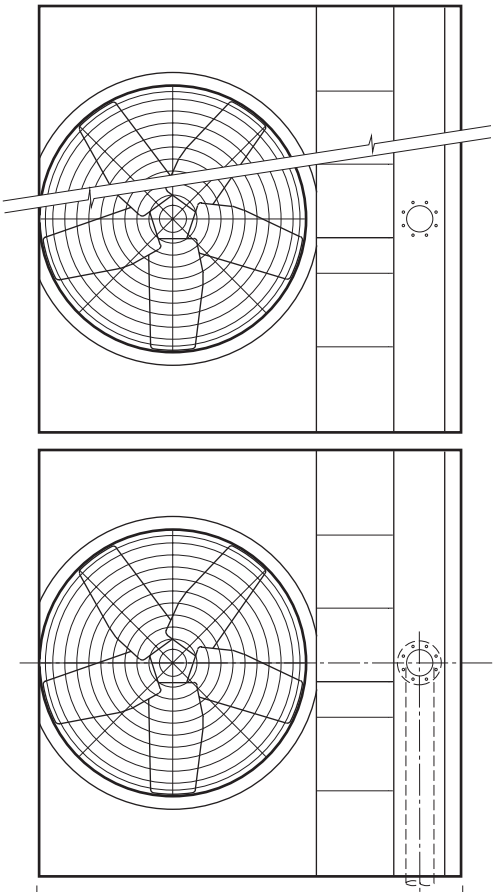
This booklet not only relates the language to use in describing an appropriate AV Series cooling tower—but also defines why certain items and features are important enough to specify with the intention of insisting upon compliance by all bidders. The left hand column of pages 14 thru 27 provides appropriate text for the various specification paragraphs, whereas the right hand column comments on the meaning of the subject matter and explains its value.

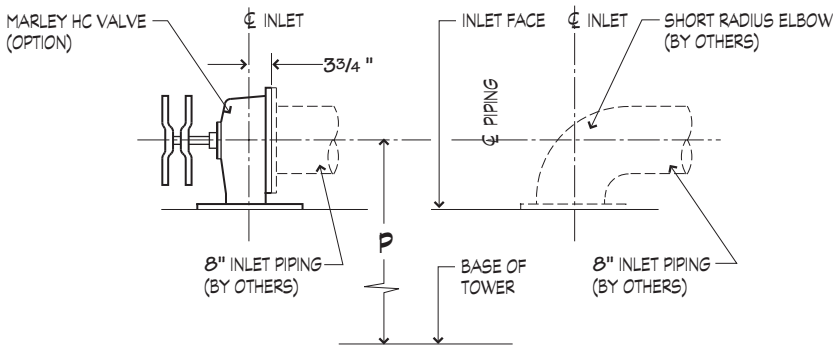
Pages 14 thru 20 indicate those paragraphs which will result in the purchase of a basic cooling tower—one that accomplishes the specified thermal performance, but which will lack many operation—and maintenance-enhancing accessories and features that are usually desired by those people who are responsible for the continued and continuing operation of the system of which the tower is part. It will also incorporate those standard materials which testing and experience has proven to provide acceptable longevity in normal operating conditions.

Pages 21 thru 27 provide paragraphs intended to add those features, components, and materials that will customize the tower to meet the user's requirements.

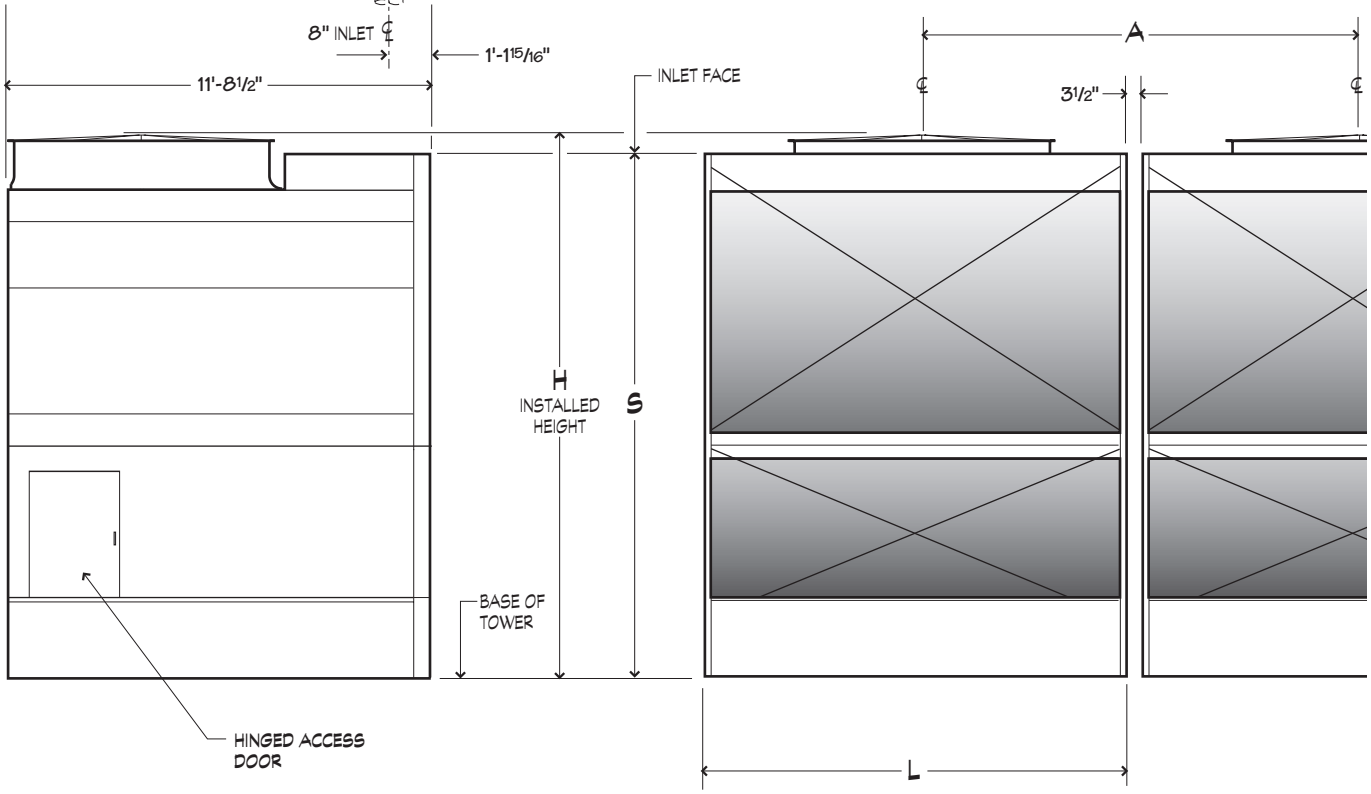
Use this data for preliminary layouts only. Obtain current drawing from your sales representative.

The UPDATE web-based selection software – available at spxcooling.com – provides AV model recommendations based on customer's specific design requirements.





INLET PIPING DETAILS



Tower Model Note 2	Nominal Tons Note 3	Dimensions					Motor hp	Design Operating Wt/Cell lb	Shipping Weight lb	
		L	H	A	S	P			Weight/ Cell	Heaviest Section
AV61001	117	8'-4"	12'-3 3/16"	8'-7 1/2"	11'-6 11/16"	12'-3 15/16"	3	8078	4237	–
AV61011	138						5	8126	4276	–
AV61021	157						7 1/2	8156	4306	–
AV61031	167						10	8335	4485	–
AV61041	195						15	8435	4585	–
AV62001	172	11'-10"	12'-3 3/16"	12'-1 1/2"	11'-6 11/16"	12'-3 15/16"	5	10771	5308	–
AV62011	193						7 1/2	10801	5338	–
AV62021	213						10	10829	5366	–
AV62031	229						15	11168	5706	–
AV62041	259						20	11212	5749	–
AV62051	275						25	11314	5851	–
AV63001	190	8'-4"	15'-2 11/16"	8'-7 1/2"	14'-6 3/16"	15'-3 7/16"	7 1/2	9893	5421	3066
AV63011	204						10	9920	5448	3093
AV63021	232						15	10197	5726	3285
AV63031	248						20	10278	5807	3366
AV63041	264						25	10370	5899	3458
AV64001	201	8'-4"	16'-7 15/16"	8'-7 1/2"	15'-11 7/16"	16'-8 11/16"	7 1/2	10467	5688	3066
AV64011	217						10	10494	5715	3093
AV64021	246						15	10785	6002	3285
AV64031	263						20	10865	6087	3365
AV64041	285						25	10958	6180	3458
AV64051	302						30	11024	6246	3524
AV65001	242	9'-10"	16'-7 15/16"	10'-1 1/2"	15'-11 7/16"	16'-8 11/16"	10	11976	6386	3470
AV65011	270						15	12076	6486	3570
AV65021	288						20	12402	6813	3771
AV65031	311						25	12506	6917	3875
AV65041	329						30	12541	6952	3910
AV65051	345						40	12709	7120	4078
AV66001	279	11'-10"	15'-2 11/16"	12'-1 1/2"	14'-6 5/16"	15'-3 7/16"	15	13263	6901	3947
AV66011	305						20	13335	6973	4019
AV66021	322						25	13710	7347	4262
AV66031	343						30	13743	7380	4295
AV66041	355						40	13912	7549	4464
AV67001	293	11'-10"	16'7 15/16"	12'-1 1/2"	15'-11 7/16"	16'-8 11/16"	15	14009	7224	3947
AV67011	320						20	14081	7296	4019
AV67021	344						25	14186	7401	4124
AV67031	365						30	14510	7724	4295
AV67041	390						40	14679	7894	4464

NOTE

1 Use this bulletin for preliminary layouts only. Obtain current drawings from your Marley sales representative. All table data is per cell.

2 Last numeral of model number indicates number of cells. Change as appropriate for your selection.

3 Nominal tons are based upon 95°F HW, 85°F CW, 78°F WB and 3 GPM/ton.

4 Standard overflow is a 4" dia. connection in the collection basin wall on the air inlet side of the tower. A 3" dia. drain connection is located below the overflow. See page 7 for details

5 Outlet sizes vary according to GPM and arrangement. See pages 6 and 7 for outlet sizes and details.

6 Makeup water connection may be 1" or 2" dia., depending upon tower heat load, water pressure, and desired connections. See page 6 for additional information.

Outlet and Makeup Piping Details

Unless otherwise specified, single-cell towers normally have a side-outlet suction appropriate for the design water flow rate—see page 7. This usually assures the lowest possible installed tower elevation. Side-suction connection pipes extend roughly 3" outside the basin, and are beveled for weld connection and also grooved for a mechanical coupling.

Outlet piping can be kept below the cold water basin level by choosing a bottom outlet connection in lieu of the side suction. Bottom outlet design conform to standard class 125 ANSI pipe flange specifications. All outlet arrangements include easily removable debris screens.

Multicell towers, intended to operate together as a common unit, are joined by steel flumes between the collection basins. These flumes equalize the operating water level between basins and also provide a flow passage from cells not equipped with outlets or makeup valves, often eliminating the need to specify an outlet and makeup valve for each cell on a multicell installation. Refer to sales drawings to obtain flow values of suctions and bottom outlets for multicell installations.

The best choice for a tower used with a remote or indoor storage tank—see page 11—or on a concrete cold water basin is usually a bottom outlet, with or without screen.

Makeup

The amount of water constantly evaporated from a cooling tower varies directly with the heat load applied. In addition to evaporation, water is normally lost to the blowdown (bleed-off) necessary to maintain dissolved solids concentration at an acceptable level in the circulating water system.

The AV tower is equipped with a float-operated, mechanical makeup valves to automatically replenish this lost water. The following tables, calculated for a concentration of 3 times normal, indicate the rate of water loss, and the size of valve(s) required. If your installation's cold water basin will drain by gravity to a remote storage tank, or if you plan a separate means of controlling makeup water, we offer a price reduction for deleting the makeup valve.

Makeup Water Flow Required–GPM to Maintain Three (3) Concentrations

Tower GPM	Cooling "Range" (hot water minus cold water)					
	5° F	10° F	15° F	20° F	30° F	40° F
200	2	3	4	5	8	10
400	3	5	8	10	15	20
600	4	8	12	15	23	30
800	5	10	15	20	30	40
1000	7	13	19	25	38	50
1500	10	19	29	38	57	75
2000	13	25	38	50	75	100
3000	19	38	57	75	113	150
4000	25	50	75	100	150	200
5000	32	63	94	125	188	250
6000	38	75	113	150	225	300
8000	50	100	150	200	300	400

NOTE

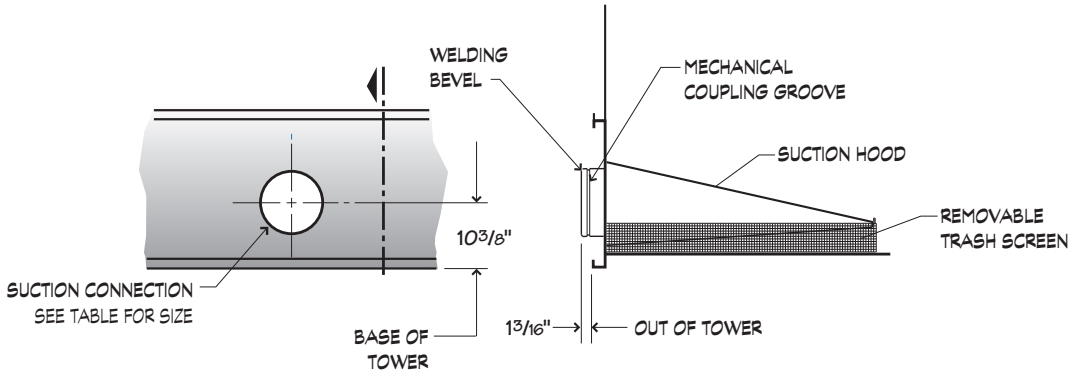
- If circulating water is to be maintained at 2 concentrations instead of 3, multiply table GPM values by 1.36 before sizing makeup valve.

Makeup Valve Flow Capacities–GPM

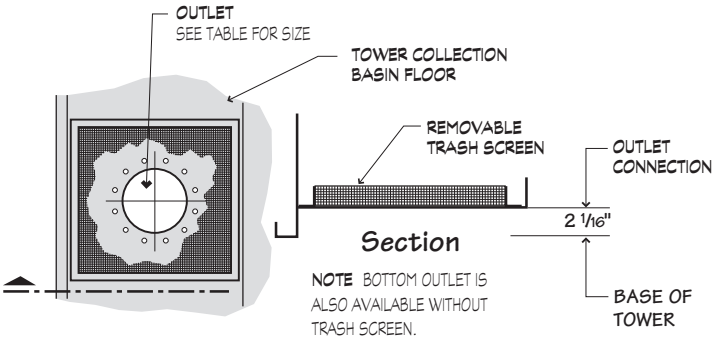
Pressure at Valve Inlet while flowing–psig	1" Diamter Valve	2" Diameter Valve
10	56	90
20	78	120
30	92	143
40	106	160
50	117	167

NOTE

- If makeup water pressure exceeds 50 psig, use pressure reducer ahead of valve.
- For flow requirements exceeding the above limitations, use multiples of the same size valve.

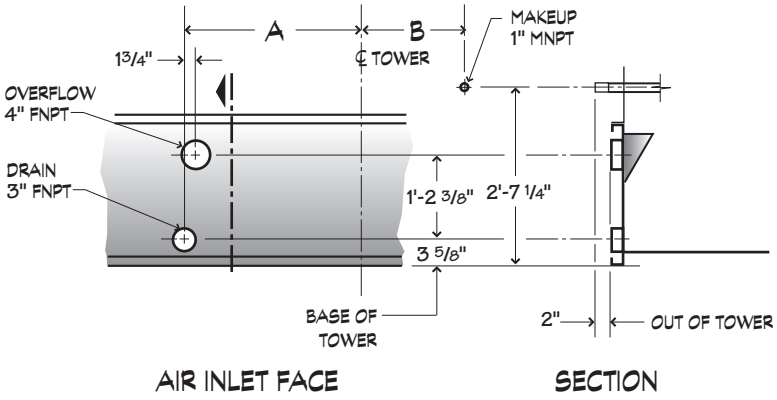


SIDE-OUTLET SUCTION CONNECTION



BOTTOM OUTLET CONNECTION

Maximum GPM Outlet					
Outlet Dia.	**Side Suction** pump flow air inlet face		**Side Suction** pump flow cased face	**Bottom Outlet** pump flow	**Bottom Outlet** pump flow w/anti-vortex plate or gravity flow
	AV61 and **AV63** thru **AV65**	**AV62** **AV66** and **AV67**	All Models	All Models	All Models
4"	–		–	71	164
6"	–		–	162	372
8"	1595		1568	287	658
10"	2562		–	453	1038
12"	–	3500	–	644	1476
14"	–		–	788	1807



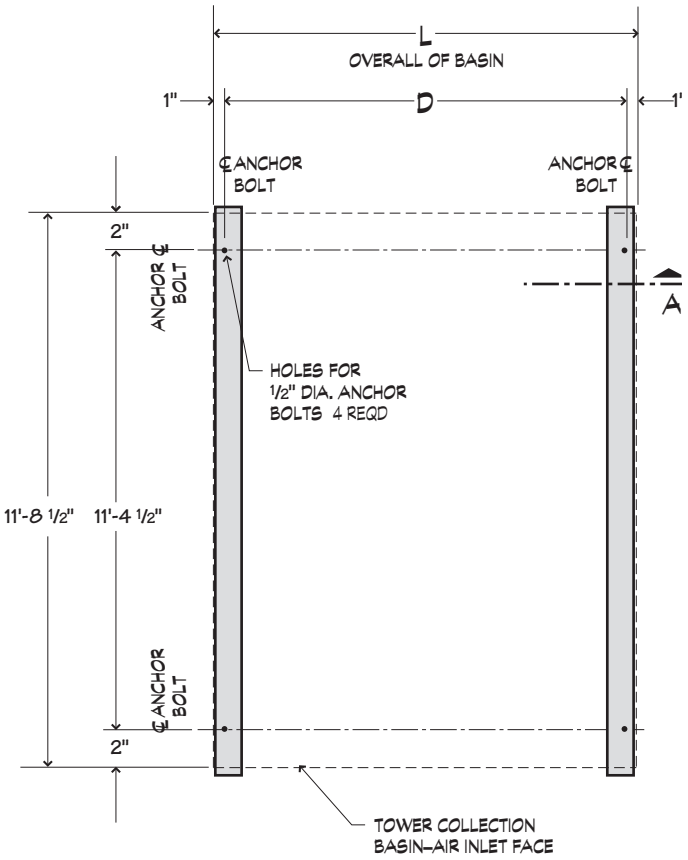
OVERFLOW, DRAIN, AND MAKEUP CONNECTION

Tower Model	Dimensions	
	A	**B**
AV61	1'-9"	3'-10"
AV62	3'-6"	5'-7"
AV63	1'-9"	3'-10"
AV64	1'-9"	3'-10"
AV65	2'-6"	4'-7"
AV66	3'-6"	5'-7"
AV67	3'-6"	5'-7"

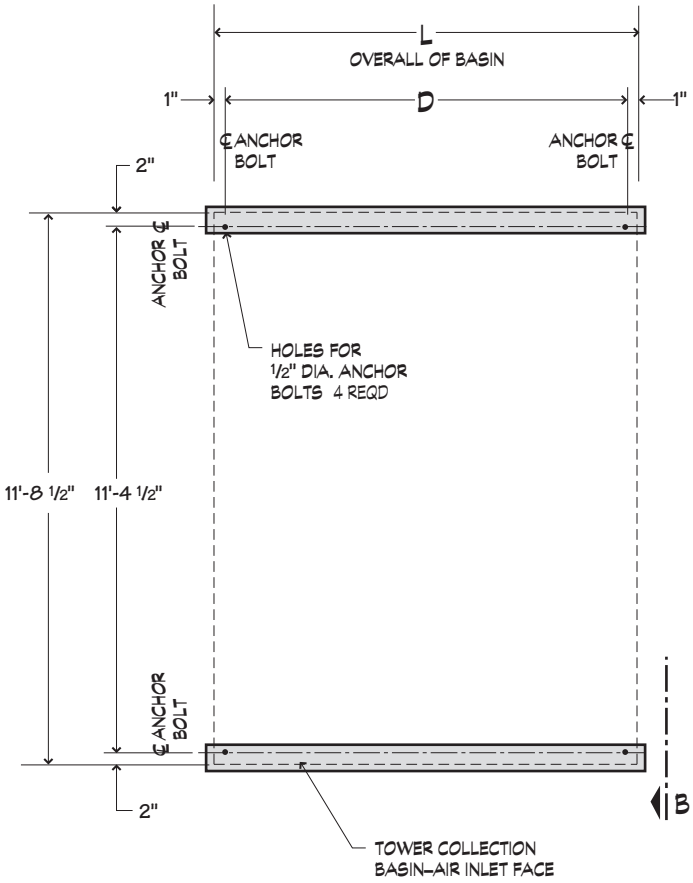
NOTE

1 For gravity-flow situations (as to an indoor tank), use bottom outlet. Side outlet suction is not recommended for gravity flow.

2 GPM limits are based on single-cell or multicell towers with a single outlet per cell. For multicell towers connected with collection basin flumes and less than one outlet per tower cell consult your Marley sales representative for more specific information.

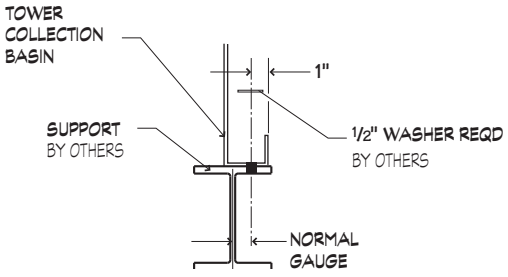


SUPPORTING STEEL
OPTION ONE

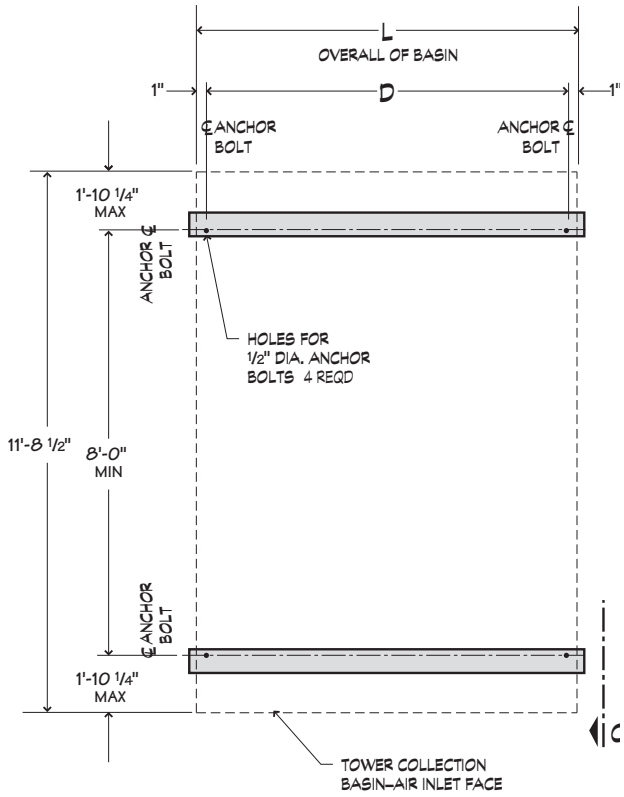


SUPPORTING STEEL
OPTION TWO

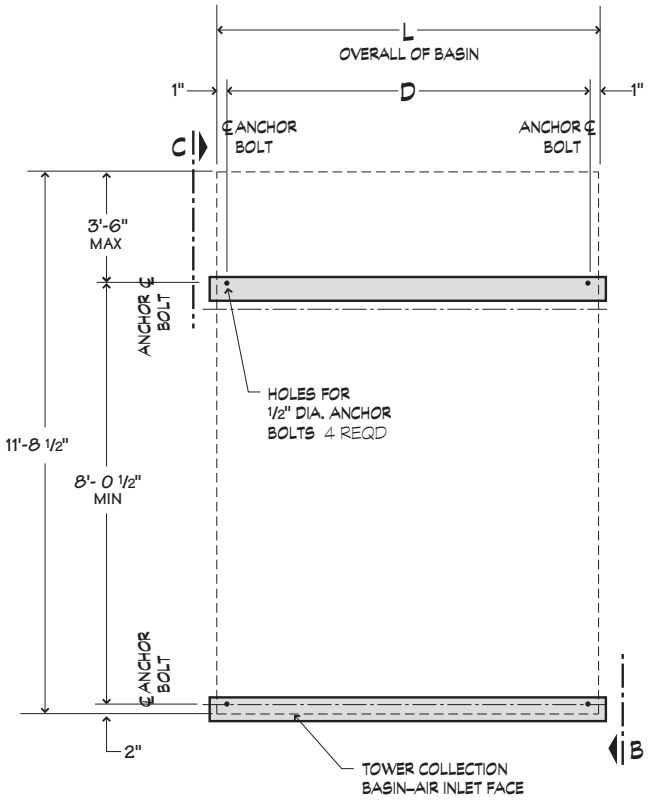
Tower Model	Dimensions		Design Operating Wt./Cell lb	Design Operating Load at Anchor lb
	L	D		
AV61000	8'-4"	8'-2"	8435	2815
AV62000	11'-10"	11'-8"	11314	3824
AV63000	8'-4"	8'-2"	10370	3436
AV64000	8'-4"	8'-2"	11024	3636
AV65000	9'-10"	9'-8"	12709	4203
AV66000	11'-10"	11'-8"	13912	4709
AV67000	11'-10"	11'-8"	14791	4939



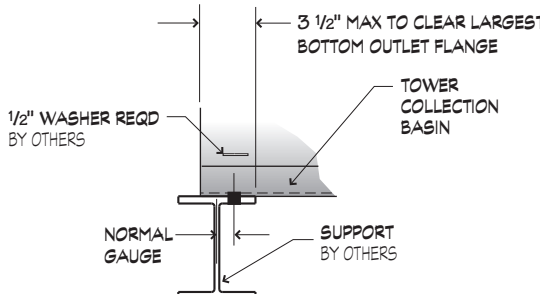
SECTION A



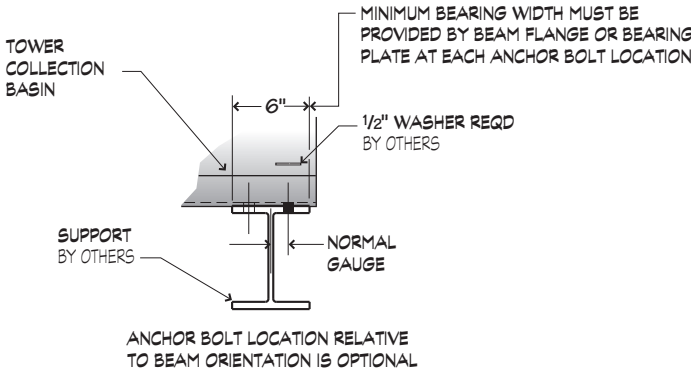
SUPPORTING STEEL
OPTION THREE



SUPPORTING STEEL
OPTION FOUR


3 1/2" MAX TO CLEAR LARGES' BOTTOM OUTLET FLANGE
1/2" WASHER REQD BY OTHERS
TOWER COLLECTION BASIN
NORMAL GAUGE
SUPPORT BY OTHERS

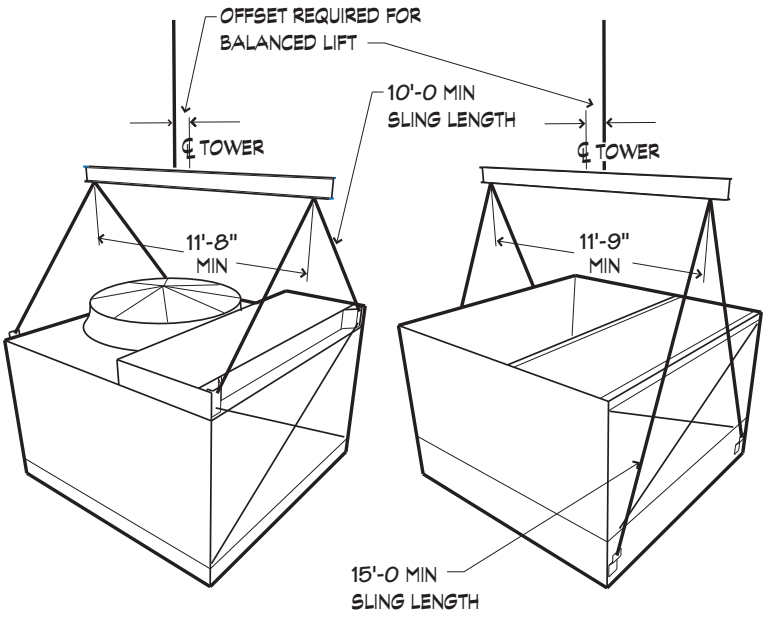
VIEW B


MINIMUM BEARING WIDTH MUST BE PROVIDED BY BEAM FLANGE OR BEARING PLATE AT EACH ANCHOR BOLT LOCATION
TOWER COLLECTION BASIN
6"
1/2" WASHER REQD BY OTHERS
SUPPORT BY OTHERS
NORMAL GAUGE
ANCHOR BOLT LOCATION RELATIVE TO BEAM ORIENTATION IS OPTIONAL

VIEW C

NOTE

1 Use this bulletin for preliminary layouts only. Obtain current drawings from your Marley sales representative for final design.
2 Grillage anchorage Option Three is not intended for use with the Bottom Outlet Option.
3 Multicell installations shall conform to arrangements shown. The standard spacing between the side face anchor bolts is 5½".
4 Purchaser to provide tower support complete with holes and anchor bolts. Do not use studs! Anchor points must be framed flush and level at top.
5 Design operating weight occurs with collection basin full to overflow level. Actual operating weight varies with GPM and piping scheme.
6 Anchorage for Supporting Steel Options One and Two are designed for 30 psf wind and/or .7g seismic loading for AV61 and AV62, 20 psf wind and/or .3g for AV63 thru AV65 and 20 psf wind and/or .46g for AV66 and AV67. Anchorage capacity for Supporting Steel Options Three and Four are less and will vary with the beam spacing.
7 Tower may be placed on a flat concrete slab. Side outlet must be specified. See pages 6 and 7 and consult your Marley application sales representative.
8 Tower may be supported from piers at each anchor bolt location, as a support alternative.



NOTE

1 All hoisting clip holes are 1¼".
2 Overall length of shackle pins should not exceed 5¼".
3 For overhead lifts or where additional safety is required, add slings beneath the tower unit.

When the ambient air temperature falls below 32°F, the water in a cooling tower can freeze. *Marley Technical Report #H-003* "Operating Cooling Towers in Freezing Weather" describes how to prevent freezing during operation. Available at spxcooling.com or ask your Marley sales representative for a copy.

During shutdown, water collects in the cold water basin and may freeze solid. You can prevent freezing by adding heat to the water left in the tower—or, you can drain the tower and all exposed pipework at shutdown.

Electric Basin Heaters

An automatic basin water heater system is available consisting of the following components:

- Stainless steel electric immersion heater(s).
  —Threaded couplings are provided in the side of the collection basin.
- NEMA 4 enclosure containing:
  —Magnetic contactor to energize heater.
  —Transformer to convert power supply to 24 volts for control circuit.
  —Solid state circuit board for temperature and low-water cutoff.
  Enclosure may be mounted on the side of the tower.
- Control probe in the collection basin to monitor water temperature and level.

Heater components are normally shipped separately for installation by others.

Note: any exposed piping that is still filled with water at shutdown—including the makeup water line—should be electrically traced and insulated (by others).

Steam Jet Basin Heater

Penberthy Houdaille bronze steam jet heaters (¼" to ¾") are available for freeze protection (installation by others). Injectors install in a coupling provided in the side of the collection basin. Live steam, as required, is injected directly into the water. Condensed steam adds water to the basin, and the excess will exit the overflow of the tower.

Indoor Storage Tank

With this type of system, water flows from an indoor tank, through the load system, and back to the tower, where it is cooled. The cooled water flows by gravity from the tower to the tank located in a heated space. At shutdown, all exposed water drains into the tank, where it is safe from freezing.

The amount of water needed to successfully operate the system depends on the tower size and GPM and on the volume of water contained in the piping system to and from the tower. You must select a tank large enough to contain those combined volumes—plus a level sufficient to maintain a flooded suction on your pump. Control makeup water according to the level where the tank stabilizes during operation.

Sound Control

Sound produced by an AV Series tower operating in an unobstructed environment will meet all but the most restrictive noise limitations—and will react favorably to natural attenuation. Where the tower has been sized to operate within an enclosure, the enclosure itself will have a damping effect on sound. Sound also declines with distance—by about 5 dBA each time the distance doubles. Where noise at a critical point is likely to exceed an acceptable limit, several options are available—listed below in ascending order of cost impact:

- In many cases, noise concerns are limited to nighttime, when ambient noise levels are lower and neighbors are trying to sleep. You can usually resolve these situations by using a two-speed motor in an 1800/900 configuration—operating the fans at half speed without cycling "after hours". The natural nighttime reduction in wet-bulb temperature makes this a very feasible solution in most areas of the world, but the need to avoid cycling may cause the cold water temperature to vary significantly.
- Where noise is a concern at all times—for example, near a hospital—the best solution is to oversize the tower so it can operate continuously at reduced (900 RPM) motor speed. Typical sound reductions at half speed are 10 dBA.
- Extreme cases may require inlet and discharge sound attenuator sections—however, the static pressure loss imposed by attenuators may necessitate an increase in tower size. This is the least desirable approach because of the significant cost impact—and because of the obstruction to normal maintenance procedures.

Your Marley sales representative will help you meet your sound requirements.

Enclosure

Occasionally, cooling towers are located inside architectural enclosures for aesthetic reasons. Although AV Series towers adapt well to enclosures, the designer must realize the potential impact of a poorly arranged enclosure on the tower's performance and operation. The designer must take care to provide generous air inlet paths, and the tower's fan cylinder discharge height should not be lower than the elevation of the top of the enclosure. Obtain a copy of *Marley Technical Report #H-004* "External Influences on Cooling Tower Performance" from your Marley sales representative.

As suggested in the aforementioned Technical Report, it may also be advisable to specify a design wet-bulb temperature 1°F higher than normal to compensate for potential recirculation initiated by the enclosure. You'll benefit from discussing your project with your Marley sales representative.

System Cleanliness

Cooling towers are very effective air washers. Atmospheric dust able to pass through the relatively small louver openings will enter the circulating water system. Increased concentrations can intensify system maintenance by clogging screens and strainers—and smaller particulates can coat system heat transfer surfaces. In areas of low flow velocity—such as the cold water basin—sedimentary deposits can provide a breeding ground for bacteria.

In areas prone to dust and sedimentation, you should consider installing some means for keeping the cold water basin clean. Typical devices include side stream filters and a variety of filtration media.

Water Treatment

To control the buildup of dissolved solids resulting from water evaporation, as well as airborne impurities and biological contaminants including Legionella, an effective consistent water treatment program is required. Simple blowdown may be adequate to control corrosion and scale, but biological contamination can only be controlled with biocides.

An acceptable water treatment program must be compatible with the variety of materials incorporated in a cooling tower—ideally the pH of the circulating water should fall between 6.5 and 8.0. Batch feeding of chemicals directly into the cooling tower is not a good practice since localized damage to the tower is possible. Specific startup instructions and additional water quality recommendations can be found in the AV Series User Manual which accompanies the tower and also is available from your local Marley sales representative. For complete water treatment recommendations, consult a competent, qualified water treatment supplier.

⚠ CAUTION

The cooling tower must be located at such distance and direction to avoid the possibility of contaminated tower discharge air being drawn into building fresh air intake ducts. The purchaser should obtain the services of a Licensed Professional Engineer or Registered Architect to certify that the location of the tower is in compliance with applicable air pollution, fire, and clean air codes.

Typical Applications

The AV Series tower can be used in normal applications requiring cold water for the dissipation of heat. This includes condenser water cooling for air conditioning, refrigeration, and thermal storage systems, as well as their utilization for free-cooling in all of those systems. They are also used in the cooling of jacket water for engines and air compressors, and are widely applied to dissipate waste heat in a variety of industrial and manufacturing processes.

Choosing the all stainless steel construction option, the AV Series can be confidently applied in unusually corrosive processes and operating environments. However, no single product line can answer all problems, and selective judgement should be exercised in the following situations

Applications Requiring Alternative Cooling Tower Selections

Certain types of applications are incompatible with any cooling tower with PVC film fill—whether AV Series or a competitive tower of similar manufacture. PVC is subject to distortion in high water temperatures, and the narrow passages typical of film-type fill are easily clogged by turbid or debris-laden water. Some of the applications, which call for alternative tower designs are:

- Water temperatures exceeding 125°F—will adversely affect the service life and performance of normal PVC fill.
- Ethylene glycol content—can plug fill passages as slime and algae accumulate to feed on the available organic materials.
- Fatty acid content—found in processes such as soap and detergent manufacturing and some food processing, fatty acids pose a serious threat for plugging fill passages.
- Particulate carry over—often found in steel mills and cement plants, can both cause fill plugging, and can build up to po-tentially damaging levels on tower structure.
- Pulp carry over—typical of the paper industry and food pro-cessing where vacuum pumps or barometric condensers are used. Causes fill plugging which may be intensified by algae.

Alternative Selections

In addition to the AV Series, we offer a full scope of Marley products in various designs and capacities to meet the special demands of specific applications.

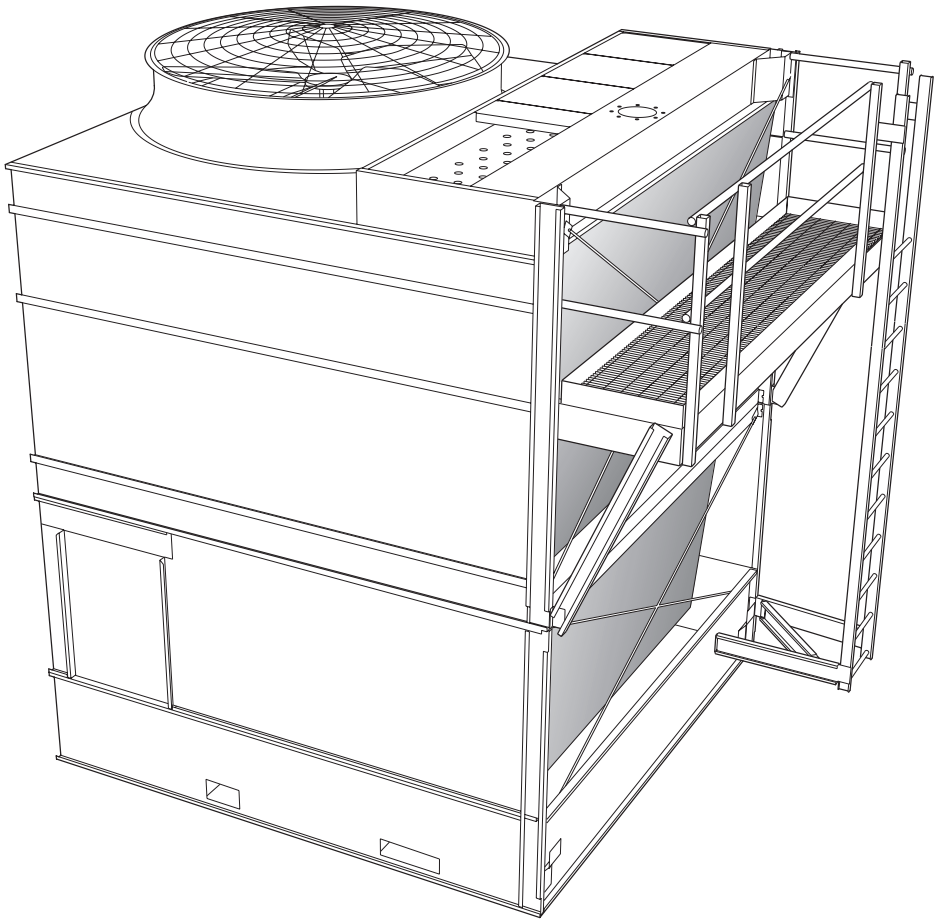
Corrosion Resistance

- QuadraFlow®—fiberglass and stainless steel construction assures long service life in virtually any environment. Five-year full product warranty. Efficient PVC film fill. Uniquely different and architecturally attractive.
- Sigma™ Series—available in wood, fiberglass, HDG steel or stainless steel structure. Field-erected for medium to large projects. Available in a wide range of sizes. Efficient PVC film fill.

Splash-Fill Towers

- Series 10 / Series 15—wood structure, fiberglass casing, with splash-type fill. Similar capacities to Sigma series towers. Proven in hundreds of installations. Excellent in “dirty water” situations.

Specifications	Specification Value
1.0 **Base:**	
1.1 Provide an induced draft, crossflow type, factory assembled, film fill, industrial duty, galvanized steel cooling tower situated as shown on the plans. The limiting overall dimensions of the tower shall be _____ wide, _____ long, and _____ high to the top of the fan guard. Total operating horsepower of all fans shall not exceed ____ hp, consisting of ___ @ _____ hp motor(s). Tower shall be similar and equal in all respects to Marley Model _____.	■ Your specification base establishes the type, configuration, base material, and physical limitations of the cooling tower to be quoted. During the planning and layout stages of your project, you will have focused your attention on a cooling tower selection that fits your space allotment, and whose power usage is acceptable. Limitations on physical size and total operating horsepower avoid the introduction of unforeseen operational and site-related influences. Specifying the number of cells, and the maximum fan hp/cell will work to your advantage. The benefit of crossflow towers is that they are inherently easy to operate, access, and maintain. Unlike counterflow towers, they have a spacious, full height plenum for easy access to all of the tower's internal components, and the water distribution system is readily open to view and cleaning. If your preference is for a stainless steel tower, or if your water or air quality suggests that the use of stainless steel is prudent, see stainless steel options on page 21.



Ladder and access platform are optional accessories. See Page 24 for specification wording.

The ladder can be located on either end of the platform by simple field rearrangement of handrails and posts.

Specifications	Specification Value

2.0 **Thermal Performance:**

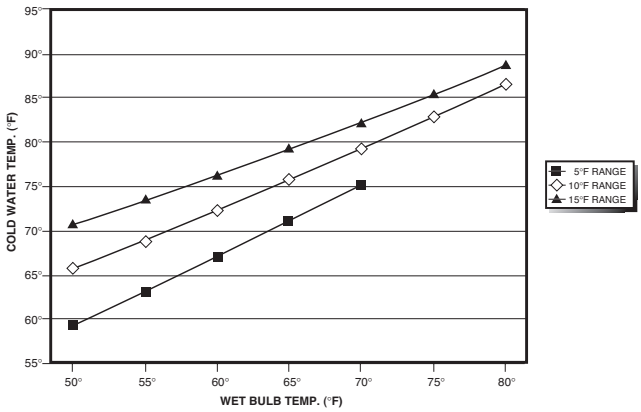
2.1 The tower shall be capable of cooling _____ GPM of water from ____ °F to _____ °F at a design entering air wet-bulb temperature of _____ °F, and its thermal rating shall be Certified by the Cooling Tower Institute.

- CTI Certification means that the tower has been tested under operating conditions and found to perform as rated by the manufacturer under those circumstances. It assures the buyer that the tower is not intentionally or inadvertently undersized by the manufacturer.

3.0 **Performance Warranty:**

3.1 CTI Certification notwithstanding, the cooling tower manufacturer shall guarantee that the cooling tower supplied will meet the specified performance conditions when the tower is installed according to plan. If, because of a suspected thermal performance deficiency, the owner chooses to conduct an on-site thermal performance test under the supervision of a qualified, disinterested third party in accordance with CTI or ASME standards during the first year of operation; and if the tower fails to perform within the limits of test tolerance; then the cooling tower manufacturer will pay for the cost of the test and will make such corrections as are appropriate and agreeable to the owner to compensate for the performance deficiency.

- However, CTI certification alone is not sufficient to assure you that the tower will perform satisfactorily in your situation. Certification is established under relatively controlled conditions, and towers seldom operate under such ideal circumstances. They are affected by nearby structures, machinery, enclosures, effluent from other towers, etc. Responsible and knowledgeable bidders will take such site-specific effects into consideration in selecting the tower–but the specifier must insist by the written specification that the designer/manufacturer guarantee this “real world” performance. Any reluctance on the part of the bidder should cause you some concern.



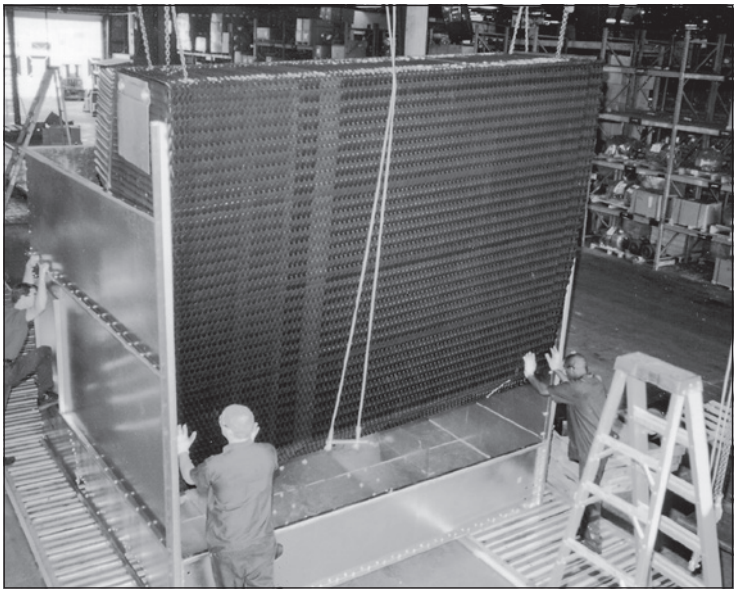
4.0 **Design Loading:**

4.1 The tower structure and anchorage shall be designed to withstand a wind load of 20 psf, as well as .3g seismic load while operating. The tower shall be designed to withstand shipping and hoisting loads of 2g horizontal and 3g vertical. Handrails, where specified, shall be capable of withstanding a 200 lb. concentrated live load in any direction, and shall be designed in accordance with OSHA guidelines. Fork lift slots shall be provided in the basin side supports to allow handling of the tower at grade level.

- The design wind and seismic loads at the left are the minimum allowables for any model in the line under accepted design standards. Some models can withstand greater loads as listed below:

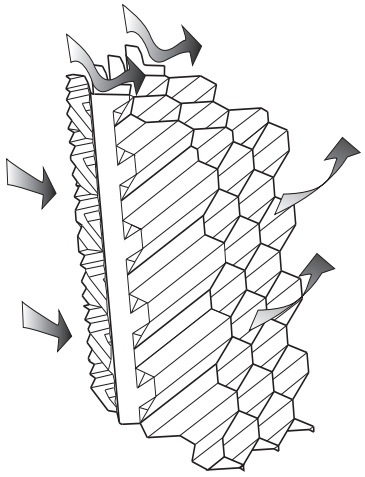
Model	*Wind*	*Seismic*
AV61 and AV62	30 psf	.7g
AV63 thru AV65	20 psf	.3g
AV66 and AV67	20 psf	.46g

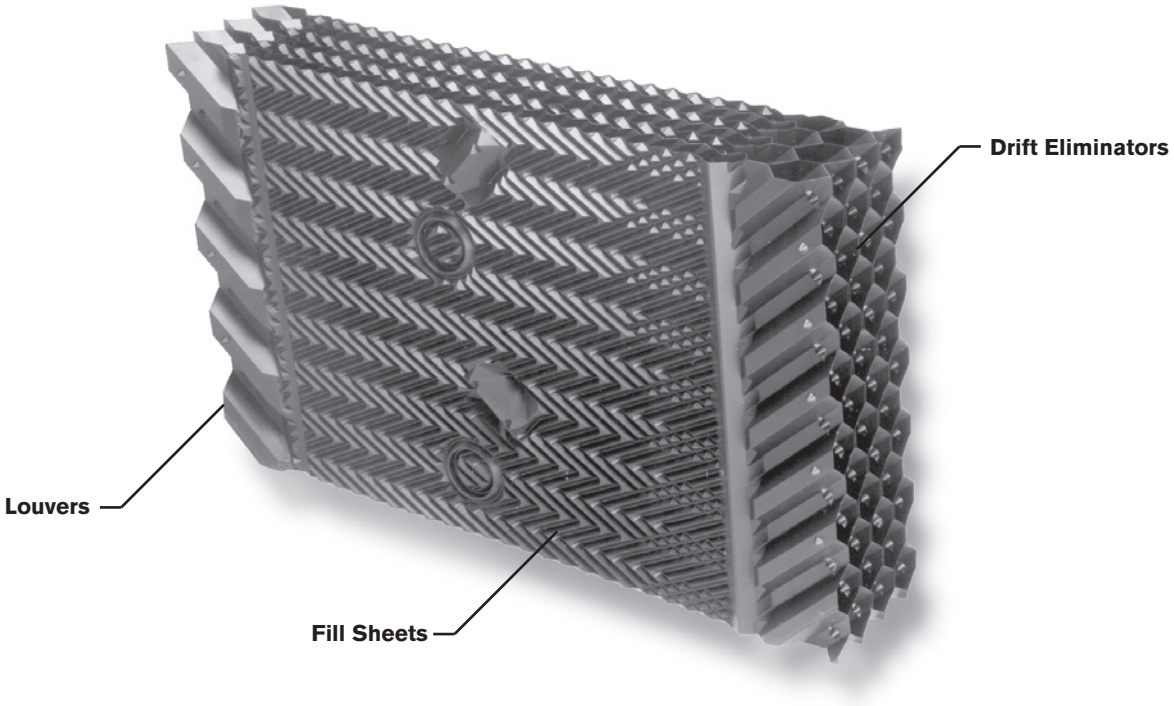
If your application requires higher loads, consult your Marley sales representative. These standards give you assurance that the tower can be shipped, handled, hoisted and ultimately operated in a normal cooling tower environment.

Specifications	Specification Value
5.0 **Construction:**	
5.1 Except where otherwise specified, all components of the cooling tower shall be fabricated of heavy-gauge steel, protected against corrosion by G-235 galvanizing. The tower shall be capable of withstanding water having a pH of 6.5 to 8.0; a chloride content (NaCl) up to 500 ppm; a sulfate content (SO4) up to 250 ppm; a calcium content (CaCO3) up to 500 ppm; silica (SiO2) up to 150 ppm; and design hot water temperatures up to 125°F. The circulating water shall contain no oil, grease, fatty acids, or organic solvents.	■ In the history of cooling towers, no other coating for carbon steel has exhibited the success and longevity of galvanization in exposure to the normal cooling tower water quality defined at left. No paints or electrostatically applied coatings, however exotic they may be, can approach galvanization's history of success. Except for those unusual operating situations where the circulating water may be so laden with suspended solids, algae, fatty acids, product fibers, active organisms reflected in BOD, and the like that plugging of the fill is a probability, reasonable attention to the construction materials and/or their coatings is all that is normally required. If your preference is for a stainless steel tower, or if your water or air quality suggests that the use of stainless steel is prudent, see stainless steel options on page 21.
5.2 The specifications, as written, are intended to indicate those materials that will be capable of withstanding the above water quality in continuing service, as well as the loads described in paragraph 4.1. They are to be regarded as minimum requirements. Where component materials peculiar to individual tower designs are not specified, the manufacturers shall take the above water quality and load carrying capabilities into account in the selection of their materials of manufacture.	 *Factory Assembly*

Specifications	Specification Value
6.0 **Mechanical Equipment**:	
6.1 Fan(s) shall be propeller-type, incorporating wide-chord aluminum alloy blades and galvanized hubs. Blades shall be individually adjustable. Fan(s) shall be driven through an industrial grade system of V-belts, pulleys, and tapered roller bearings. Bearings shall be rated at an L10A service life of 40,000 hours or greater.	■ Propeller-type fans require only half the operating hp of blower-type fans. However, they should be readily adjustable to permit compensation for job site conditions that may tend to overload the motor. The fans of one manufacturer require the purchase of special positioners for each increment of fan blade pitch.
6.2 Motor(s) shall be ____ hp maximum, Totally Enclosed, 1.15 service factor, variable torque, and specially insulated for cooling tower duty. Speed and electrical characteristics shall be _____ RPM, single-winding, ___ phase, ____ hertz, ____ volts.	Unless otherwise specified, motor speed will be 1800 RPM in 60 Hertz areas and 1500 RPM in 50 Hertz areas. If you prefer the operating flexibility of two-speed operation, please specify the RPM to be 1800/900 (1500/750 in 50 Hertz regions). Incidentally, two speed motors are a far better choice than separate “pony” motors which simply double the problems indicated above.
6.3 The fan and fan drive assembly for each cell shall be supported by a rigid, welded, hot dip galvanized steel structural support that resists misalignment. The mechanical equipment assembly shall be warranted against any failure caused by defects in materials and workmanship for no less than five (5) years following the date of tower shipment. This warranty shall cover the fan, speed reducer, drive shaft and couplings, and the mechanical equipment support. The electric motor shall carry a manufacturer's warranty of at least one year. The bearing assemblies and V-belts shall be warranted for 18 months.	If your preference is for a stainless steel tower, or if your water or air quality suggests that the use of stainless steel is prudent, see stainless steel options on page 21.

Specifications	Specification Value
7.0 **Fill, Louvers, and Drift Eliminators:**	
7.1 Fill shall be film-type, thermoformed of 15 mil thick PVC, with louvers formed as part of each fill sheet. Fill shall be suspended from hot-dip galvanized structural tubing supported from the tower structure, and shall be elevated above the floor of the cold water basin to facilitate cleaning. The air inlet face of the tower shall be free of water splash-out.	■ Louvers integral with the fill keep the flowing water within the confines of the fill. The separate external louvers used by others permit water to escape the fill and form ice or produce an unsightly situation adjacent to the tower. If you plan to use your tower in the wintertime, particularly for free cooling, integral louvers will put your operating concerns to rest.
7.2 Drift eliminators shall be PVC, triple pass, and shall limit drift losses to 0.005% or less of the design water flow rate.	■ Drift rate varies with design water loading and air rate, as well as drift eliminator depth and number of directional changes. A drift rate of 0.001% is readily available on many standard models. If a lower rate is required, please discuss with your Marley sales representative.





Specifications	Specification Value
8.0 **Hot Water Distribution System:**	
8.1 An open basin above the bank of fill shall receive hot water piped to each cell of the tower. The distribution basin shall be installed and sealed at the factory, and shall be equipped with removable, galvanized steel covers to keep out leaves and debris, and to retard the growth of algae.	■ Gravity-flow distribution basins are a feature of crossflow type towers, resulting in operating pump heads of from 10 to 20 feet less than that encountered in counterflow towers with pressurized spray systems. Also, these basins are out where they can be easily inspected–even maintained–while the tower is in operation. Spray systems of counterflow towers, sandwiched between the top of the fill and the drift eliminators, are extremely awkward to access and maintain. If your preference is for a stainless steel tower, or if your water or air quality suggests that the use of stainless steel is prudent, see stainless steel options on page 21.
8.2 The basin shall include an inlet hole and bolt circle to accept a 125# flange connection per ANSI B16.1. Removable, interchangeable polypropylene nozzles installed in the floor of these basins shall provide full coverage of the fill by gravity flow.	
9.0 **Casing, Fan Deck, and Fan Cylinder:**	
9.1 The casing and fan deck shall be heavy-gauge galvanized steel, and shall be capable of withstanding the loads described in paragraph 4.1. The fan cylinder shall be molded FRP, and shall be through-bolted to the fan deck to provide a consistently stable operating shroud for the fan. The top of the fan cylinder shall be equipped with a conical, non-sagging, removable fan guard, fabricated of welded 5/16" and 7 gauge rods, and hot-dip galvanized after fabrication.	

Specifications	Specification Value
10.0 **Access:**	
10.1 Large galvanized steel access doors 30" wide and a minimum of 42" high shall be located in both endwalls for entry into the cold water basin and fan plenum area. Access doors shall be operable from inside as well as outside the tower.	■ The access doors on competitive towers may be 18" wide or smaller, which is unreasonably small for a human being. Specifying the size of the door will cause those bidders to take exception, alerting you to a potential maintenance headache. Two doors are standard on all towers so that access between cells of multicell towers is assured.
11.0 **Cold Water Collection Basin**:	
11.1 The cold water basin shall be heavy-gauge galvanized steel, and shall include the number and type of suction connections required to accommodate the outflow piping system shown on the Plans. Suction connections shall be equipped with galvanized debris screens. A factory-installed, float-operated, mechanical makeup valve shall be included. A 3" diameter drain and a 4" diameter overflow shall be provided in each cell of the tower. The basin shall include a depressed section into which accumulated silt can be flushed to permit cleaning. The basin floor adjacent to the depressed section shall slope toward the depressed section to prevent buildup of silt under the fill area. Towers of more than one cell shall include flumes for flow and equalization between cells.	■ Choose from side suctions and bottom outlets to accommodate a significant variety of piping schemes. Unless so specified, the tower you may be asked to approve may only be available with one type of suction connection, requiring you to redesign your piping layout. If your preference is for a stainless steel tower, or if your water or air quality suggests that the use of stainless steel is prudent, see stainless steel options on page 21.

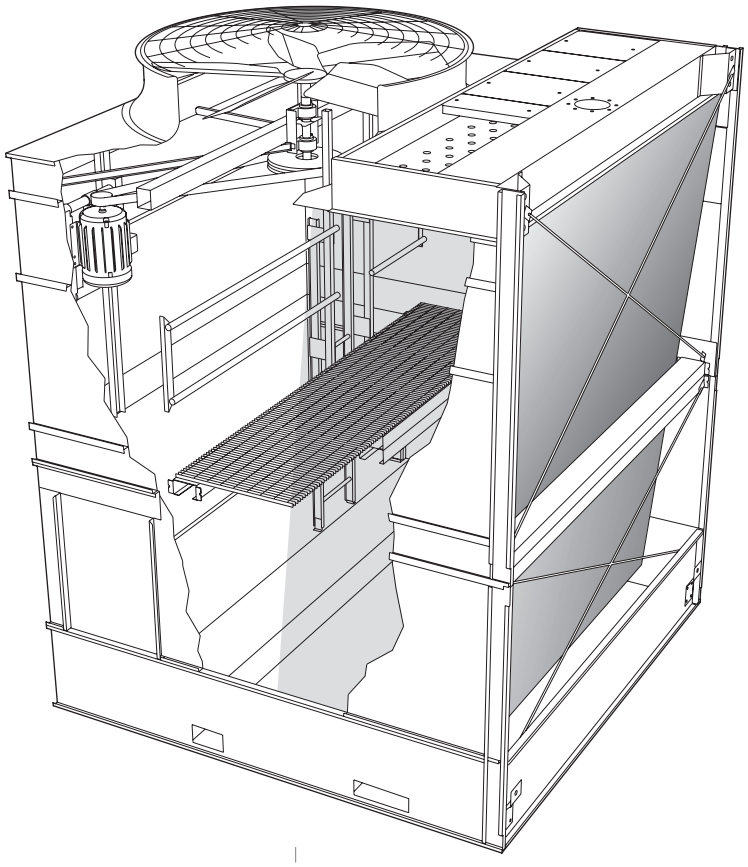
Specifications	Specification Value
Stainless Steel Options	
Stainless Steel Collection Basin:	
11.1: *Replace paragraph 11.1 with the following:* The cold water basin shall be heavy-gauge Series 300 stainless steel, and shall include the number and type of suction connections required to accommodate the outflow piping system shown on the Plans. Suction connections shall be equipped with stainless steel debris screens. A factory-installed, float-operated, mechanical makeup valve shall be included. A 3" diameter drain and a 4" diameter overflow shall be provided in each cell of the tower. The basin shall include a depressed section into which accumulated silt can be flushed to permit cleaning. The basin floor adjacent to the depressed section shall slope toward the depressed section to prevent buildup of silt under the fill area. Towers of more than one cell shall include stainless steel flumes for flow and equalization between cells. All steel items which project into the basin (columns, diagonals, anchor clips, etc.) shall also be made of stainless steel.	■ The cold water basin is the only part of the tower that is subject to periods of stagnant water, concentrated with treatment chemicals and customary contaminants. It is also the most expensive and difficult part of any tower to repair or replace. For these reasons, many customers–particularly those who are replacing older towers–choose to specify stainless steel cold water basins. Also, see the notes on page 20 regarding the standard Cold Water Collection Basin. They apply equally well to the stainless steel basin.
8.1: *Replace paragraph 8.1 with the following:* A stainless steel open basin above the bank of fill shall receive hot water piped to each cell of the tower. The distribution basin shall be installed and sealed at the factory, and shall be equipped with removable, stainless steel covers to keep out leaves and debris, and to retard the growth of algae.	■ The corrosion potential of contaminated water increases with temperature–and these basins see the hottest water in the tower. If your design hot water temperature is over 125°F, or if your operating system can produce excursions beyond that point, you would be well advised to consider this option. It would also be advisable to change the fill support tubes in Para. 7.1 from galvanized structural tubing to 300 stainless steel structural tubing. See notes regarding Section 8.0 on page 19.
All Stainless Cooling Tower	
5.1 *Replace paragraph 5.1 with the following:* Except where otherwise specified, all components of the cooling tower shall be fabricated of heavy-gauge, series 300 stainless steel. The tower shall be capable of withstanding water having a chloride content (NaCl) up to 750 ppm; a sulfate content (SO4) up to 1200 ppm; a calcium content (CaCO3) up to 800 ppm; silica (SiO2) up to 150 ppm; and design operating ranges up to 50°F. The circulating water shall contain no oil, grease, fatty acids, or organic solvents.	■ Where water quality falls outside the limits indicated in Paragraph 5.1, an all-stainless tower is worthy of your consideration.

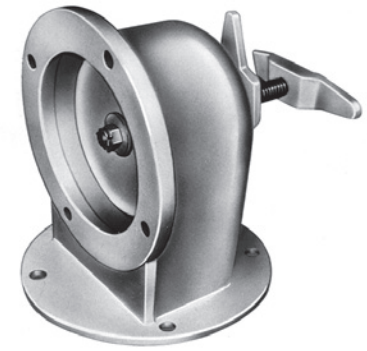
Specifications	Specification Value
Control Options	
Fan Motor Starter Control Panel:	
6.4 *Add the following paragraph in the Mechanical Equipment section:* Each cell of the cooling tower shall be equipped with a UL / CUL 508 listed control panel in a NEMA 3R or 4X outdoor enclosure capable of controlling single-speed or two-speed motors as required, and designed specifically for cooling tower applications. The panel shall include a main circuit breaker or main fused disconnect with an external operating handle, lockable in the off position for safety. Full voltage non-reversing magnetic starter shall be controlled with a thermostatic or solidstate temperature controller. Door mounted selector switches shall be provided to enable automatic or manual control and wired for 120VAC control. Control circuit to be wired out to terminal blocks for field connection to a remote vibration switch, overload trip alarms and remote temperature control devices. The temperature controller shall be adjustable for the required cold-water temperature. If a thermostatic controller is used it shall be mounted on the side of the tower with the temperature sensing bulb installed in the cold water basin using a suspension mounting bracket. If a solid-state temperature controller is used the controller will be door mounted on the control panel. The solid-state temperature controller will display two temperatures, one for outgoing water and the other for set point. Water temperature input shall be obtained using a three-wire RTD with dry well in the outlet water piping and wired back to the solid-state temperature controller in the control panel.	■ If it is your opinion that the control system for the cooling tower should be part of the tower manufacturer's responsibility, we are in wholehearted agreement with you. Who better to determine the most efficient mode and manner of a tower's operation–and to apply a system most compatible with it–than the designer and manufacturer of the cooling tower?
Marley TF Terminal Box:	
6.4 *Add the following paragraph in the Mechanical Equipment section:* A factory installed terminal box shall be furnished and mounted to the outside of the tower where applicable. The fan motor and optional components–including the vibration switch and water level probes–shall be factory wired to terminal points inside the terminal box. Optional tower components which ship loose, including the oil level switch and immersion heaters shall be field wired to the terminal	■ The Marley TF Terminal Box simplifies all electrical connections to the cooling tower motor and optional control accessories. • Eliminates wiring errors in the field • Reduces field wiring labor and materials • Provides an external access location to internal cooling tower wiring • NEMA 4X fiberglass enclosure suitable for corrosive applications • Terminal points are well identified • UL 508 assembly

Specifications	Specification Value
box. Enclosure shall be NEMA 4X fiberglass with hinged and lockable door meeting UL 508, CSA and IEC standards. Terminal box shall include lockable stainless steel snap-latch door fasteners, terminal blocks marked with wire numbers, sub-pan and a wiring diagram. Complete assembly shall be built to UL 508A standards. Conduit entry and exit points shall be the bottom of the enclosure preventing water collection in the enclosure.	
Vibration Limit Switch:	
6.5 *Add the following paragraph in the Mechanical Equipment section:* A single-pole, double-throw vibration limit switch in a NEMA 4 housing shall be installed on the mechanical equipment support for wiring into the owner's control panel. The purpose of this switch will be to interrupt power to the motor in the event of excessive vibration. It shall be adjustable for sensitivity, and shall require manual reset.	■ Unless specified otherwise, a Marley M-5 vibration switch will be provided. The requirement for manual reset assures that the cooling tower will be visited to determine the cause of excessive vibration.
Basin Heaters:	
11.2 *Add the following paragraph in the Cold Water Basin section:* Provide a system of electric immersion heater prevent freezing of water in the collection basin during periods of shutdown. The system shall consist of one or more stainless steel electric immersion heaters installed in threaded couplings provided in the side of the basin. A NEMA 4 enclosure shall house a magnetic contactor to energize heaters; a transformer to provide 24 volt control circuit power; and a solid state circuit board for temperature and low water cutoff. A control probe shall be located in the basin to monitor water level and temperature. The system shall be capable of maintaining 40°F water temperature at an ambient air temperature of __ °F.	■ The basin heater components described at left are recommended for a reliable automatic system for the prevention of basin freezing. They are normally shipped separately for installation at the job site by the installing contractor. When purchased in conjunction with the enhanced Control System option, however, they are customarily factory-mounted and tested. Submerged in basin water, in which zinc ions are present, copper immersion heaters must not be used. Insist upon stainless steel. The ambient air temperature that you fill in should be the lowest 1% level of winter temperature prevalent at site. Ask for appropriate Marley drawing.

Specifications	Specification Value
Convenience and Safety Options	
Hot Water Basin Access Platform:	
10.2 *Add the following paragraph in the Access section:* Provide an external platform near the top of the louver face for access to the hot water distribution system. The platform shall be galvanized steel bar grating, supported by galvanized steel framework attached to the tower. The platform shall be surrounded by a handrail, kneerail, and toeboard. A permanently attached 1'-6" wide aluminum ladder with 3" I-beam side rails and 1.25" diameter serrated rungs shall extend from the base of the tower to the top of the handrail.	■ Periodic inspection and maintenance of a cooling tower distribution system is fundamental to preserving maximum cooling system efficiency. All cooling towers–crossflow or counterflow–are subject to clogging to varying degrees by waterborne contaminants such as pipe scale and sediment. Therefore, safe and easy access to these components is of significant value to the operator. Access can be provided in a number of ways, including portable ladders or scaffolding, but for maximum safety and convenience, a factory installed Marley access platform with guardrails makes this task as safe and user-friendly as possible. Further, its location on the side of the tower does not add to the height of the unit, preserving architectural integrity. See graphic, Page 14. It also saves the owner time and money, in that maintenance personnel may devote their time to inspection rather than searching for ladders or erection of portable scaffolding.
Ladder Extension:	
10.2 *Add the following to the end of the Hot Water Basin Access Platform paragraph:* Provide a ladder extension for connection to the foot of the external ladder. This extension shall be long enough to rise from the roof (grade) level. The installing contractor shall be responsible for cutting the ladder to length; attaching it to the foot of the tower ladder; and anchoring it at its base.	■ Many towers are installed such that the base of the tower is 2'-0" or more above the roof or grade level. This makes it difficult to get up to the foot of the attached ladder. The ladder extension alleviates this problem. Marley ladder extensions are available in standard 5'-0" and 11'-0" lengths.
Ladder Safety Cage:	
10.2 *Add the following to the end of the Hot Water Basin Access Platform paragraph:* A heavy gauge galvanized steel safety cage shall surround the ladder, extending from a point 7'-0" to 8'-0" above the foot of the ladder to the top of the distribution basin access platform handrail.	■ To meet OSHA guidelines, towers whose distribution basin access platforms are 20'-0" or more above roof or grade, and which are equipped with external ladders, should have safety cages surrounding the ladders.

Specifications	Specification Value
Mechanical Equipment Access Platform: *Available only on AV63000 models and larger.* 10.3 *Add the following paragraph in the Access section:* Provide an internal platform approximately 7' below the level of the fan for access to the mechanical equipment. The platform shall be galvanized steel bar grating, supported by galvanized steel framework attached to the tower. The platform shall be surrounded by a handrail and kneerail. A permanently attached 1'-6" wide aluminum ladder with 3" I-beam side rails and 1.25" diameter serrated rungs shall extend from the cold water basin to the top of the handrail.	■ Periodic inspection and maintenance of cooling tower fans, motors and other rotating equipment is fundamental to preserving maximum cooling system efficiency. All mechanical draft cooling towers–forced or induced draft–are subject to vibration and wear. Therefore, safe and easy access to these components for inspection and maintenance is of significant value to the operator. Access can be provided in a number of ways, including portable ladders or scaffolding, but for maximum safety and convenience, a factory installed Marley access platform with guardrails makes this task as safe and user-friendly as possible. See graphic below. It also saves the owner time and money, in that maintenance personnel may devote their time to inspection rather than searching for ladders or erection of portable scaffolding.



Specifications	Specification Value
Miscellaneous Options	
Fan Cylinder Extensions:	
9.1 *Insert the following after the first sentence:* Fan cylinder extensions shall be provided to elevate the fan discharge to a height of ___ ft. above the top of the standard fan cylinder.	■ Extensions are available in 11¾" increments to a maximum extension height of 6'-10¼". Such extensions may be considered necessary in order to elevate the discharge beyond the bounds of an enclosure. Discuss applicability with your local Marley sales representative.
Equalizer Flume Weir Gates:	
11.2 *Add the following paragraph under Cold Water Collection Basin:* The interconnecting flume between cells shall be equipped with a removable cover plate to permit the shutdown of one cell for maintenance purposes, or to permit independent cell operation.	■ Where it is your intention to be able to operate other cells of the tower while the flume cover plate is installed, separate outlet connections, float valves, and overflows must be provided for each cell. Likewise, this would require separate sensors and controls for basin heater systems, if installed.
Marley Control Valve:	
8.3 *Add the following paragraph under Hot Water Distribution System:* A heavy-duty, industrial grade flow-control valve shall be provided at the inlet to the hot water basin. The valve shall permit both flow balancing on multicell towers and temporary shut-off for maintenance of selected cells. Valve shall have a machined cast iron body, with stainless steel operating stem, and heavy-duty locking handle.	
Premium Efficiency Motor:	
6.3 *Replace paragraph 6.3 with the following:* The fan and fan drive assembly for each cell shall be supported by a rigid, welded, hot dip galvanized steel structural support that resists misalignment. The mechanical equipment assembly shall be warranted against any failure caused by defects in materials and workmanship for no less than five (5) years following the date of tower shipment. This warranty shall cover the fan, speed reducer, motor, drive shaft and couplings, and the mechanical equipment support. The bearing assemblies and V-belts shall be warranted for 18 months.	■ NEMA premium efficiency motor with a five year warranty enhances the standard five year mechanical equipment warranty of the AV cooling tower.

Specifications	Specification Value
FM Approval:	
Available only on multi-cell towers.	
5.3 *Add the following paragraph in the Construction section:* The tower shall include all design and material modifications necessary to meet the fire rating requirements of Factory Mutual. The product proposed shall be listed in the FM Approval Guide, latest edition.	■ This could have a very beneficial effect upon your fire insurance premiums. Towers not able to meet FM requirements may require the inclusion of a fire protection sprinkler system to achieve a comparable level of insurance premium cost. Even if you are not insured by FM, this requirement ensures that each cell will contain any fire that may occur without losing the ability of limited operations and capacity.
Low Noise Tower:	
1.2 *Add the following paragraph under Base:* The cooling tower shall be quiet operating, and shall produce an overall level of sound no higher than ____ dBA, measured at the critical location indicated on the Plans.	■ Sound produced by a AV Series tower operating in an unobstructed environment will meet all but the most restrictive noise limitations–and will react favorably to natural attenuation. Where the tower has been sized to operate within an enclosure, the enclosure itself will have a damping effect on sound. Sound also declines with distance–by about 5 or 6 dBA each time the distance doubles. Where noise at a critical point is likely to exceed an acceptable limit, you have several options–listed below in ascending order of cost impact: • Where only a slight reduction in noise will satisfy–and the source of concern is in a particular direction–merely turning the tower may be the answer. Less sound emanates from the cased face of the tower than does from the air intake face. • In many cases, noise concerns are limited to nighttime, when ambient noise levels are lower and neighbors are trying to sleep. You can usually resolve these situations by using two-speed motors in 1800/900 configuration; and operating the fans at half-speed without cycling “after hours”. (The natural nighttime reduction in wet-bulb temperature makes this a very feasible solution in most areas of the world, but the need to avoid cycling may cause the cold water temperature to vary significantly.) • Where noise is a concern at all times (for example, near a hospital), the best solution is to oversize the tower so it can operate continuously at half (900 RPM) motor speed even at the highest design wet-bulb temperature. A typical sound reduction is 10 dBA at ½ fan speed, but larger reductions are often possible. • Extreme cases may require special fans or inlet and discharge sound attenuator sections; however, the static pressure loss imposed by attenuators may necessitate an increase in tower size. This is the least desirable approach because of the significant cost impact–and because of the obstruction to normal maintenance procedures. Your Marley sales representative can help you meet your sound requirements.

LENNTECH
info@lenntech.com Tel. +31-152-610-900
www.lenntech.com Fax. +31-152-616-289

SPX
COOLING TECHNOLOGIES

7401 WEST 129 STREET
OVERLAND PARK, KANSAS 66213
UNITED STATES
913 664 7400
spxcooling@spx.com
spxcooling.com

In the interest of technological progress,
all products are subject to design and/or
material change without notice.
©2010 SPX Cooling Technologies, Inc.
Printed in USA | AV-TS-10